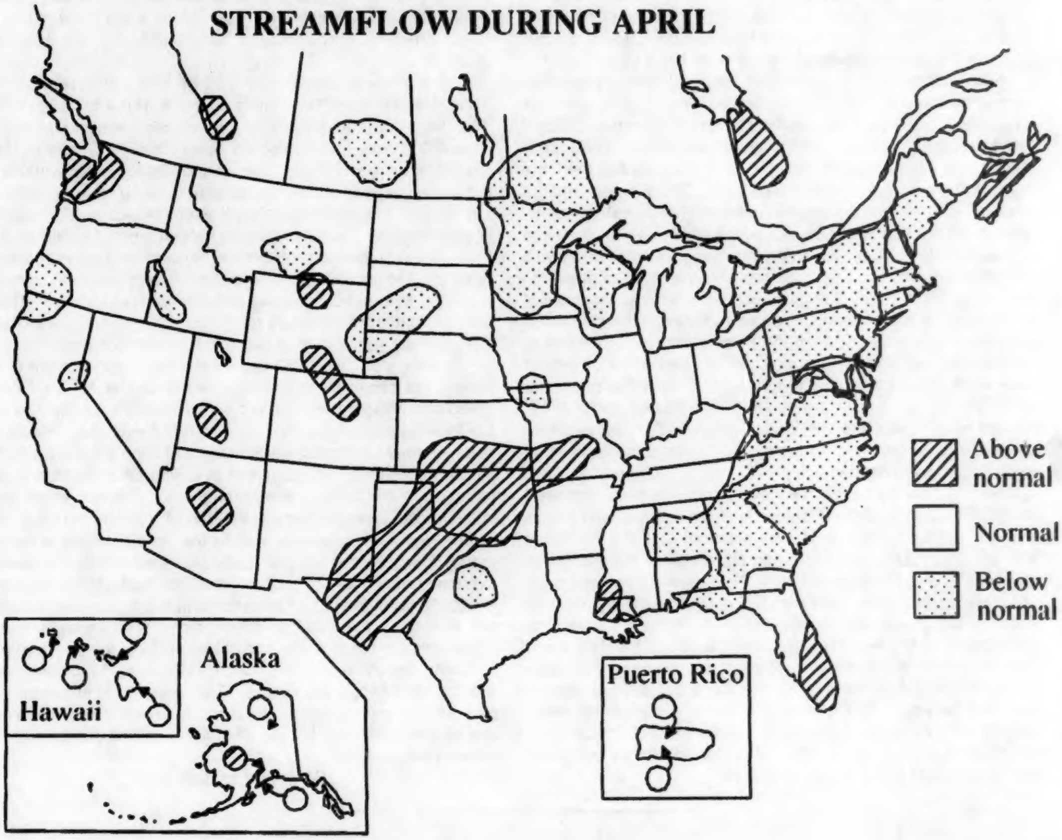
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

APRIL 1988

STREAMFLOW DURING APRIL



April streamflow increased in 2 of the 3 areas in the West where streamflow has been below median for several months, and also increased in the Southeast, after above-normal precipitation fell in much of both areas during April. Total April streamflow at the 17 index stations in the States of Oregon, Washington, Idaho, and Montana increased 126 percent and was 6 percent below the total median. In California, total streamflow at the six index stations was 27 percent below the total median after a 40 percent increase from March to April. In Nevada and Utah (Great Basin only), total streamflow at the four index stations decreased 10 percent from March to April and was 47 percent below the total median. In the Southeast, total streamflow at the 39 index stations was 40 percent below the total median after increasing by 4 percent from that for March.

Streamflow was in the normal to above-normal range at 66 percent of the index stations in southern Canada, the United States, and Puerto Rico, the second lowest percentage of stations with flow in the normal to above-normal range for April in the last 6 years. Total April flow for the 181 reporting index stations in the conterminous United States and southern Canada was 13 percent below median and the lowest for April in the last 6 years.

Mean April elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) were lower than those for April 1987.

The elevation of Utah's Great Salt Lake was 4,209.45 feet above National Geodetic Vertical Datum (NGVD) of 1929 on April 30, 0.05 foot lower than on April 1.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--was 8 percent below median during April, after increasing by 26 percent from March to April, and was the second lowest for March in the last 6 years.

Contents of 63 percent of reporting reservoirs were near or above average for the end of April, compared with the 60 percent in those categories for March.

SURFACE-WATER CONDITIONS DURING APRIL 1988

Streamflow was in the normal to above-normal range at 66 percent of the 191 reporting index stations in southern Canada, the United States, and Puerto Rico, compared with the 60 percent in those ranges for last month. This is the second lowest percentage of stations with flow in the normal to above-normal range for April in the last 6 years. Total April flow of 2,569,200 cubic feet per second (cfs) for the 181 index stations in the conterminous United States and southern Canada was 13 percent below median and the lowest for April in the last 6 years, despite a 32 percent increase in streamflow from March to April. This was the only below-median April in the last 6 years.

Precipitation during April 1988 (page 4) was greater than normal over much of the Southeast and West, although there were areas of below-normal precipitation. The Palmer Drought Severity map for April 30, 1988 (page 5), shows that precipitation during April has not significantly changed the extent of the large area of extreme drought in either area. The Palmer Drought Severity map shows prolonged (months and years) abnormal wetness or dryness which changes little from week to week and reflects long-term runoff, recharge, and deep percolation, as well as evapotranspiration. One measure of the amount of precipitation needed to end drought conditions is the "additional precipitation needed to bring index near zero" which is calculated from the data used to develop the Palmer Drought Index maps. To bring the index near zero, precipitation during the oncoming week must be near the average for that week plus the "additional precipitation." A map showing the "additional precipitation" needed as of April 30, 1988, is also on page 5. In those areas where there is extreme drought, 4-13 inches of "additional precipitation" were needed.

The only new April extremes were maximums which occurred at two stations in southern Canada, a sharp contrast with March conditions when 11 new minimums occurred--2 in the West and 9 in the Southeast . Monthly mean discharge of the Northeast Margaree River at Margaree Valley, Nova Scotia (drainage area 142 square miles), was 1,924 cfs--125 percent above the median and 116 cfs greater than the previous April maximum, which occurred in 1968. Monthly mean discharge of the Harricana River at Amos, Quebec (drainage area 1,420 square miles), was 6,820 cfs--200 percent above the median and 1,020 cfs greater than the previous April maximum, which occurred in 1953. Hydrographs on page 6 show flow conditions of the last 26 months at 8 sites: 4 in the West, 2 in Canada (those with new April maximums) and 2 in the Southeast.

Drought occurred in most of the Southeast during 1986, with both 1985, and to a lesser extent, 1987 drier than normal. Drought is again occurring in the Southeast this year. In the West, drought occurred in 1987 and is continuing in 1988. The areal extent of the 1987 drought in the West was at its greatest in June. At that time, streamflow was in the below-normal range in parts of California, Nevada, Washington, British Columbia, Alberta, Montana, Wyoming, Colorado, Utah, and all of Idaho. Four maps illustrate streamflow conditions in the West during the past 12 months: May and June 1987, and March and April 1988 (page 8).

There are 66 index reservoirs or reservoir systems in the West. Normal maximum usable contents at the 66 ranges from 130,768 acre-feet (Angostura Reservoir, South Dakota) to 31,620,000 acre-feet (Colorado River Storage Project). There are no index reservoirs in Kansas and Oregon. The symbols on the maps (page 9) show the status of actual usable contents for the end of the month displayed with respect to the average usable contents (period of record) for that month. A difference of more than 5 percent of normal maximum usable contents between the actual monthly contents and average monthly contents was used to demarcate the average range. The 5 percent limit for the average range was chosen in order to make this portrayal sensitive to changes in reservoir contents.

In 1987, contents of 59 of the 66 index reservoirs are in the average or above-average range at the end of May. Of the 7 reservoirs with contents in the below-average range, 3 are in California and 2 are in Idaho. The cumulative effects of below-normal streamflow during May and June are shown by the June contents map: 10 reservoirs in California, Washington, and Idaho are in the below-average range, including two which were in the above-average range at the end of May. Seven reservoirs in States where streamflow was in the normal to above-normal range during both May and June had contents in the below-average range for the end of June. In 1988, the cumulative effects of many months of streamflow in the below-normal range are shown by the number of reservoirs with contents in the below-average range at the end of March: 18 of the 25 reservoirs in California, Washington, Idaho, Montana, Wyoming, and Nevada (excluding Lake Powell). After a month of above-normal precipitation and normal-range streamflow in much of the West during April, only 11 of those 25 reservoirs had contents in the below-average range.

(Continued on page 7.)

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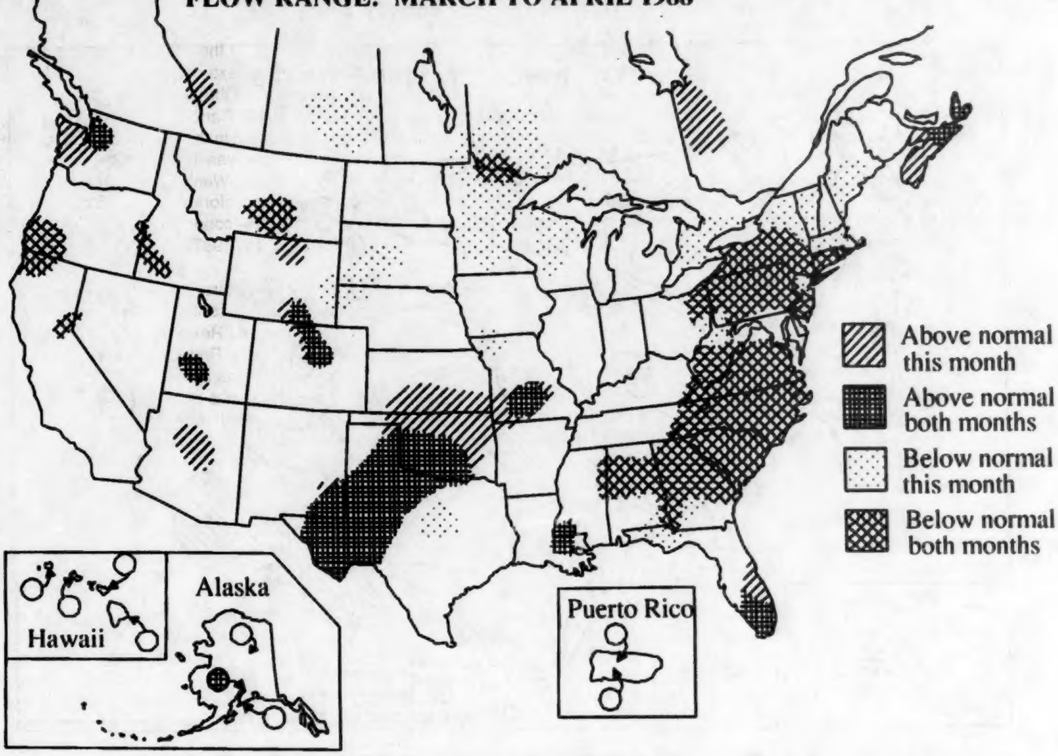
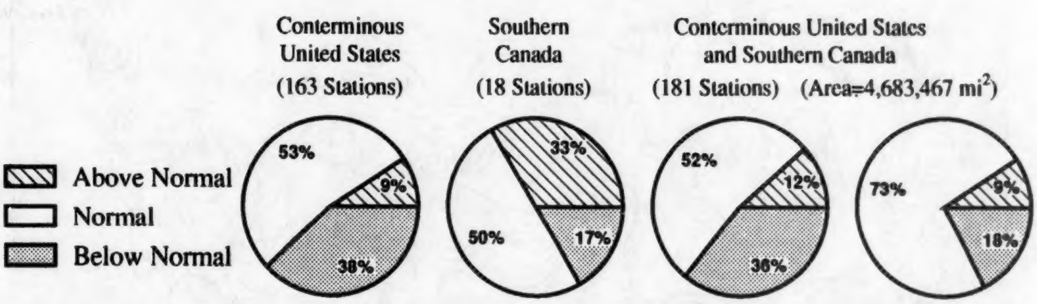
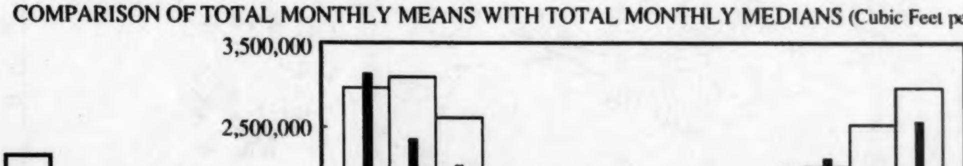
PERSISTENCE IN, OR MOVEMENT INTO, THE BELOW-NORMAL OR ABOVE-NORMAL FLOW RANGE: MARCH TO APRIL 1988

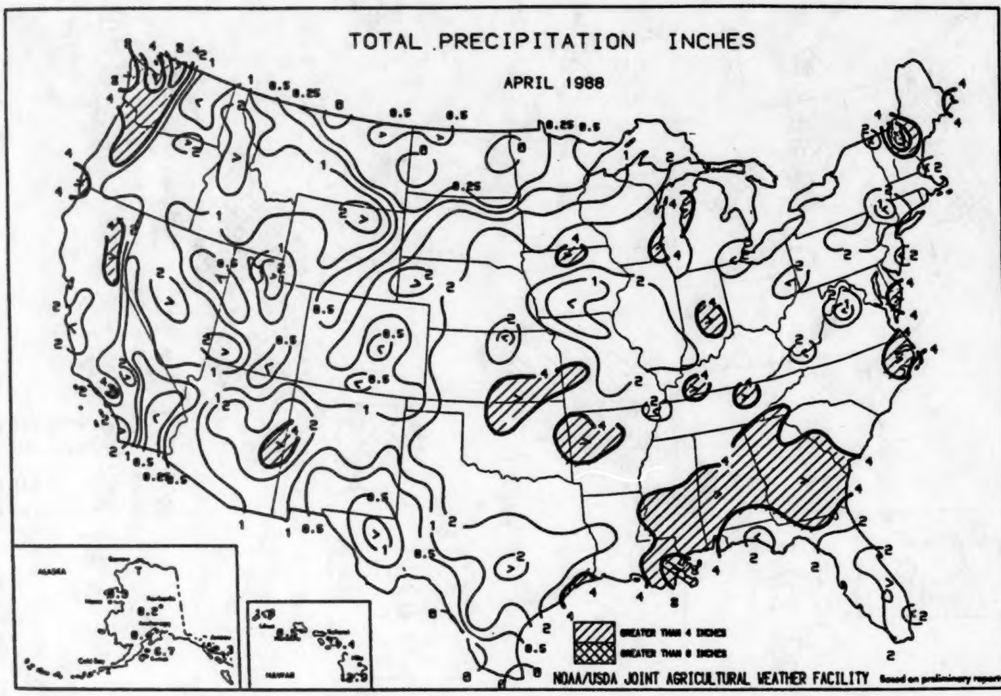


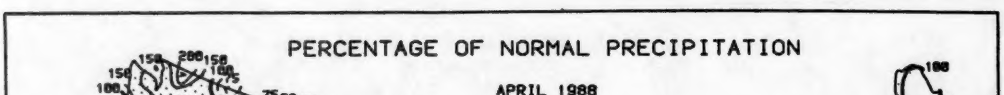
SUMMARY OF APRIL 1988 STREAMFLOW FLOW RANGES



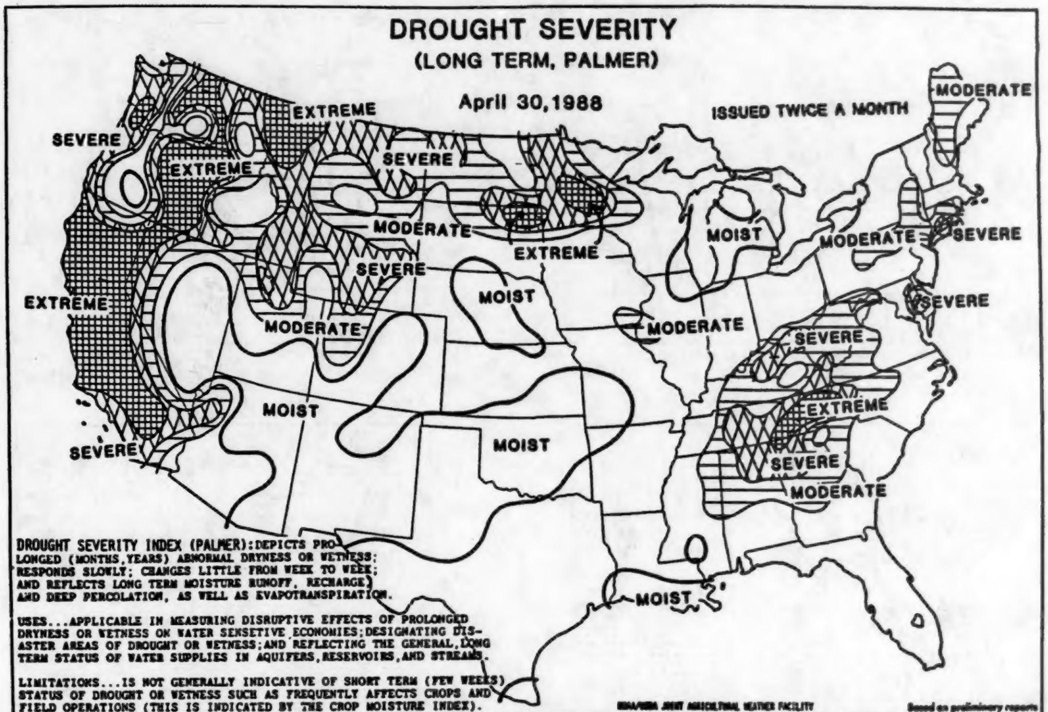
COMPARISON OF TOTAL MONTHLY MEANS WITH TOTAL MONTHLY MEDIANS (Cubic Feet per Second)

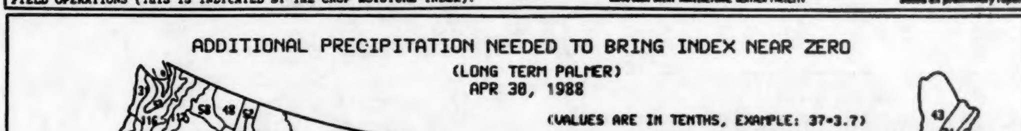






(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Weather Facility)

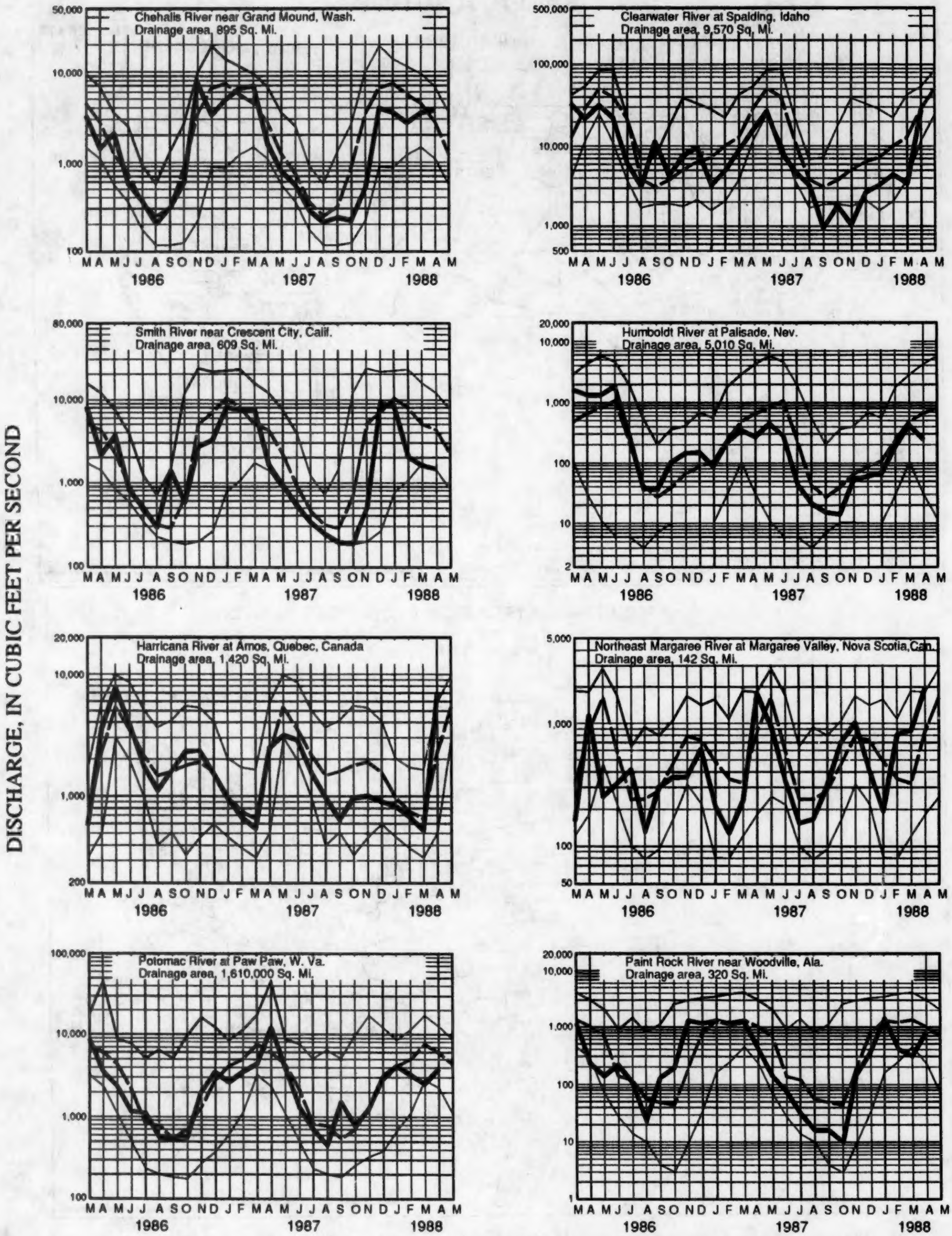




(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Weather Facility)

MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



However, although 10 of the 12 reservoirs in Montana, Idaho, and Washington had significant increases in contents during April, all but 2 (Lake Chelan in Washington and the Upper Snake River system in Idaho-Wyoming) had less water in storage at the end of April 1988 than at the end of April 1987.

In California, including Lake Tahoe, 7 of 10 reservoirs had contents in the below-average range and all except Millerton Lake had contents which were below the April 1987 contents. Only Millerton Lake had a significant increase in contents during April, and only Shasta Lake had a significant decrease in contents during the month.

The April 1988 streamflow conditions and persistence/change maps show that streamflow in much of the West increased into the normal range in most of the area where streamflow had been in the below-normal range during March. The increase was caused by above-normal April precipitation. However, the below-normal snowpack and soil-moisture deficits in most of the West combine to produce an outlook for less than median, and probably below-normal range streamflow in those areas dependent upon snowmelt for sustained spring-summer runoff. In the Southeast, above-normal rainfall increased streamflow to the point that no record lows occurred during April, but streamflow remained in the below-normal range. Below-normal range streamflow also occurred in parts of the Northeast and southern Canada.

Two series of graphs (pages 10-11) portray streamflow conditions at index stations in six areal groupings: (1) southern Canada; (2) the conterminous United States; (3) the Southeast; (4) Montana, Idaho, Washington, and Oregon; (5) California; and (6) Nevada and Utah, Great Basin only. The first series of graphs compares actual monthly streamflow for May 1987-April 1988 and median monthly streamflow (middle of the range of the 30 actual monthly values for the 1951-80 reference period). The second series of graphs shows the monthly departure of actual streamflow during October 1982-April 1988 from median streamflow for the 1951-80 reference period. These graphs show that a period of generally above-median streamflow in these areas has ended. Narrative descriptions of streamflow conditions in these six areas follow. Graphs and narratives for both southern Canada and the conterminous United States are only presented to give a general overview of conditions in the two nations because of great differences in hydrology within these two countries.

In southern Canada, actual streamflow is based on data from 18 index stations, most of them in the east. Streamflow has been below median for 10 of the last 12 months. After four consecutive months of below-median streamflow through March 1988, April streamflow increased 165 percent from that for March and was 26 percent above median.

The departure from median graph shows that streamflow has been below median for 32 of the last 44 months since September 1985.

In the conterminous United States, actual streamflow is based on data from 163 index stations. Streamflow has been below median for 8 of the last 12 months, the last two consecutive, as of April 1988. April streamflow increased 24 percent from that for March but was 16 percent below median.

The departure from median graph shows that streamflow was generally near or above median from October 1982 through December 1986, but that streamflow has generally been below median since January 1987. The periods of below-median streamflow in the Southeast and parts of the West are reflected in this graph.

In the Southeast, actual streamflow has been below median for 10 of the last 12 months, 7 of them consecutive, as of the end of April 1988. (The Southeast includes those States in the area from the Mississippi River to the Atlantic Ocean and south of the Ohio River-Pennsylvania State Line.) Total April streamflow at the 39 index stations was 40 percent below median. March streamflow was 54 percent below median. Total streamflow in the Southeast has been at least 24 percent below median since October 1987. In 4 of the last 6 months, streamflow has been lower than the streamflow in the comparable months of 1985-86 which preceded the drought of 1986 in the Southeast.

The departure from median graph for October 1982-April 1988 clearly shows the 1986 drought as 10 consecutive months of below-median streamflow. During the current dry period, 17 new monthly minimums occurred at index stations from June 1987 through April 1988. Nine of those minimums occurred in March 1988, at sites from West Virginia to Alabama. For example, streamflow of the Potomac River at Paw Paw, West Virginia (110 years of record), was 10 percent below the previous low and 67 percent below median for March.

In Montana, Idaho, Washington, and Oregon, drought has persisted for 12 consecutive months as of the end of March 1988. Actual March 1988 streamflow (17 index stations) was 35 percent below median, despite above-average precipitation in parts of the area during that month. There has been some improvement recently. During April 1988, actual streamflow at the index stations in these States increased by 126 percent from that for March but was still 6 percent below median.

However, late spring and summer streamflow in these Pacific Northwest States is highly dependent on precipitation during the preceding December-February period. Departure of precipitation from normal for that period in 1987-88 was highly variable in the four States, but based on a few National Weather Service index sites, was as follows: Montana, 19-73 percent below normal; Idaho, 15-46 percent below normal; Washington, 37 percent above normal to 34 percent below normal; and Oregon, 1-37 percent below normal. As of May 11, 1988, streamflow in Washington and Oregon, which was decreasing after the heavy rains in preceding weeks, was approaching that which occurred prior to the heavy rains.

The comparative graph shows that actual streamflow for the last 12 months was much less than the median streamflow until April 1988. The graph also shows that median streamflow increases from March through June, with the largest increases occurring from April to May (56 percent) and May to June (82 percent). The June median is somewhat greater (8 percent) than the May median. The increases in median streamflow which occur from March through June are usually caused by snowmelt. If the snowpack is below normal, increases in streamflow also can occur because of above-average precipitation in the form of rain. Since the snowpack is generally below normal in the four-State area and the adjacent Canadian Provinces, any significant sustained increase in streamflow will have to be caused by rainfall in excess of that required to satisfy soil-moisture deficits. About 38 percent of the total annual runoff in these States usually occurs in May (18 percent) and June (20 percent). About 20 percent of the annual total runoff is split evenly between March and July.

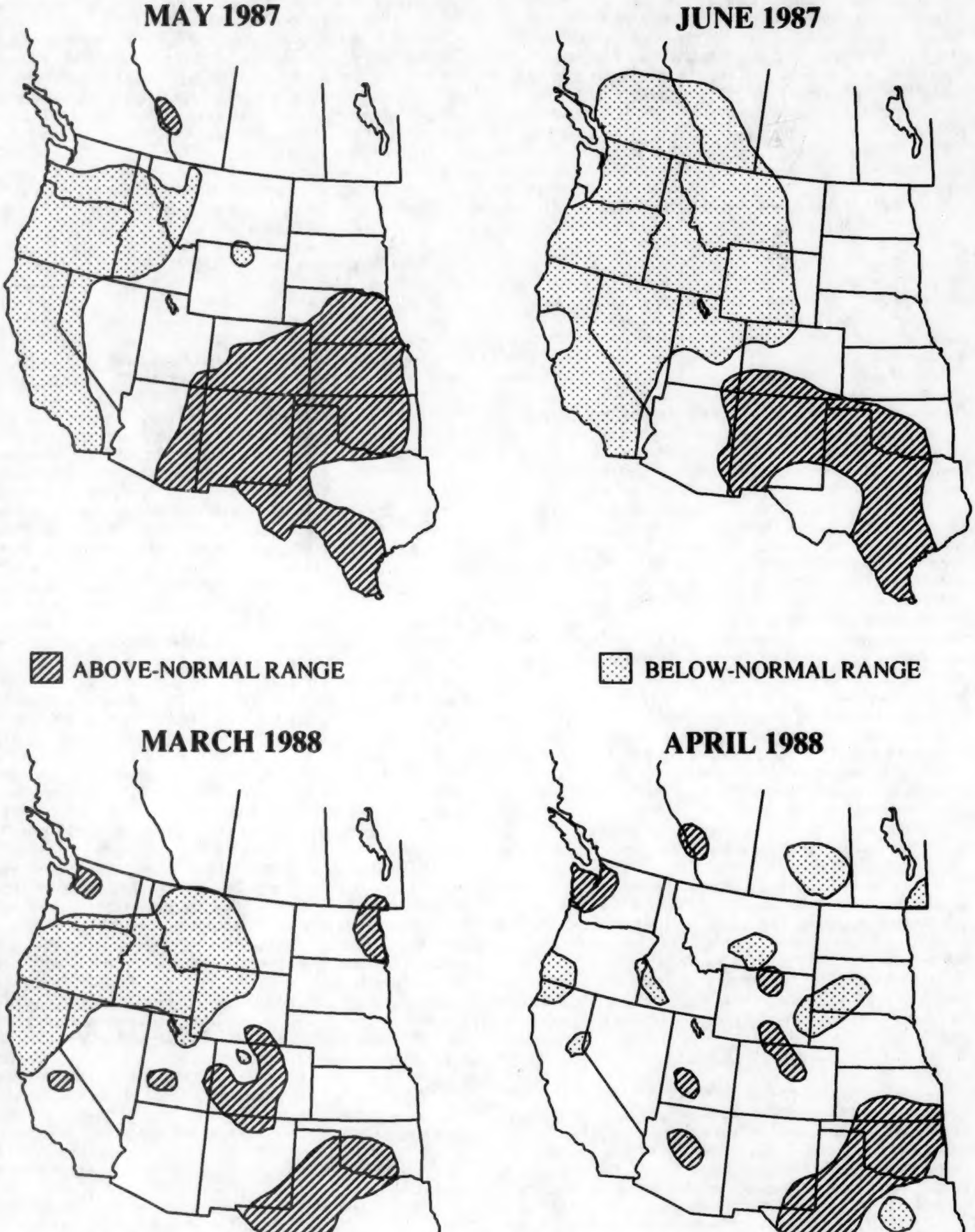
The departure from median graph shows that total streamflow was at least 18 percent below median for every month from December 1986 through March 1988, except during March 1987, when total streamflow was 5 percent above the median. Since October 1982, streamflow was generally above median through 1983 and 1984 but has been generally below median since then.

In California, actual streamflow at the six index stations has been below median for eight consecutive months since September 1987, ranging from 14 percent below median (December 1987) to 65 percent below median (March 1988). No new April minimums occurred and there was only one new March minimum: mean monthly streamflow of the Smith River near Crescent City (56 years of record), was 6 percent below the previous low for the month and 68 percent below median. September 1987 streamflow at the same site was also a monthly low, 15 percent below the previous September low, and 32 percent below median. There have been no other new lows reported for the index stations in California during the September 1987-April 1988 period. About 54 percent of the total annual runoff in California usually occurs from December through March, with February the highest month (17 percent). The graph shows that actual streamflow has been below median for the last 8 months and also that the months of highest median streamflow are over.

Since January 1985, streamflow at the index stations has been below median in 30 of the last 40 months, including the last 8 consecutive months. April 1988 streamflow at the index stations was 27 percent below median, despite increasing by 42 percent from that for March.

(Continued on page 19.)

STREAMFLOW IN THE WEST



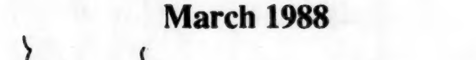
RESERVOIR CONTENTS IN THE WEST

May 1987

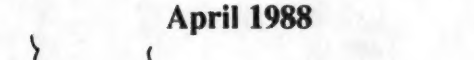
June 1987

ABOVE-AVERAGE RANGE   AVERAGE RANGE   BELOW-AVERAGE RANGE

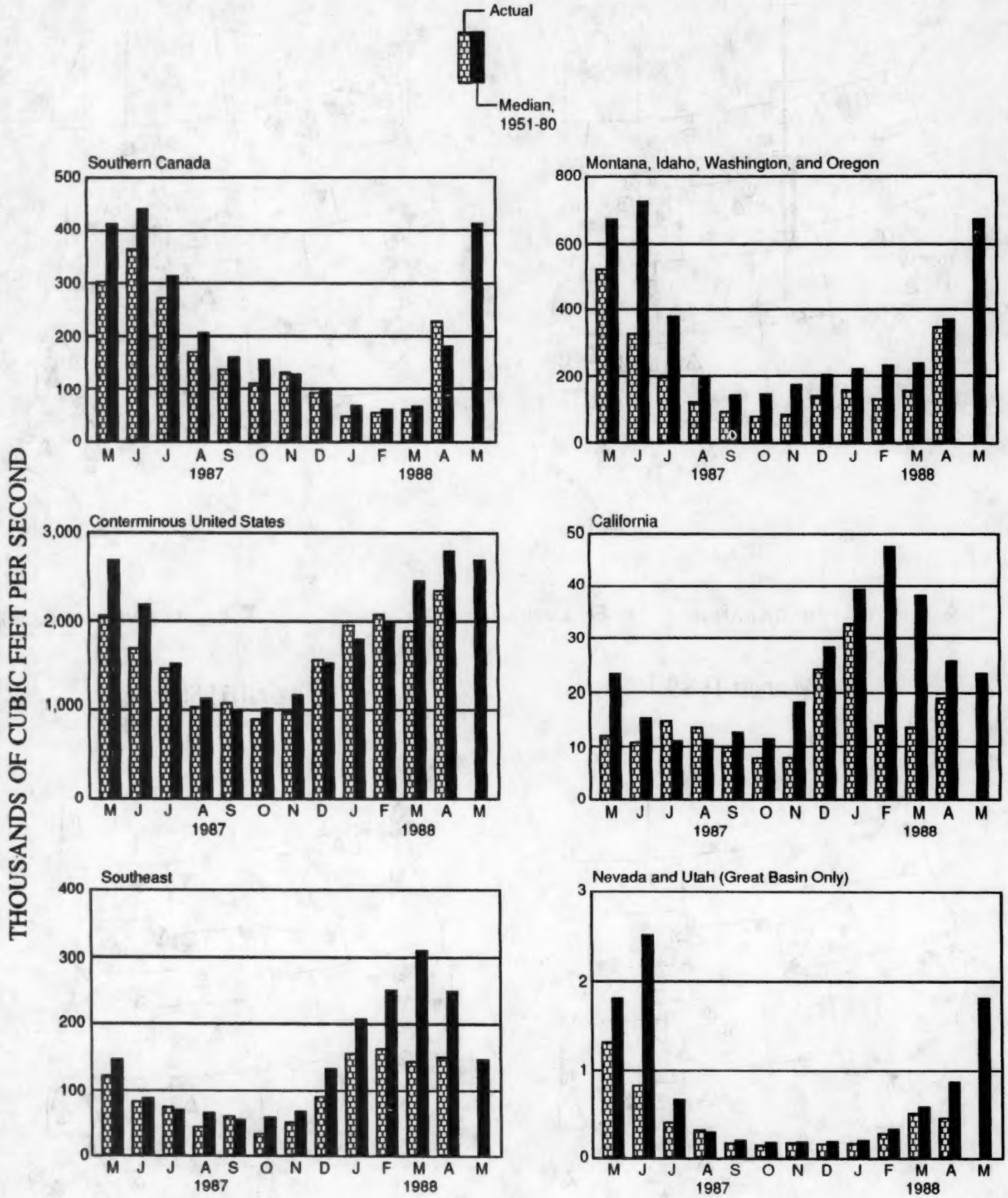
March 1988



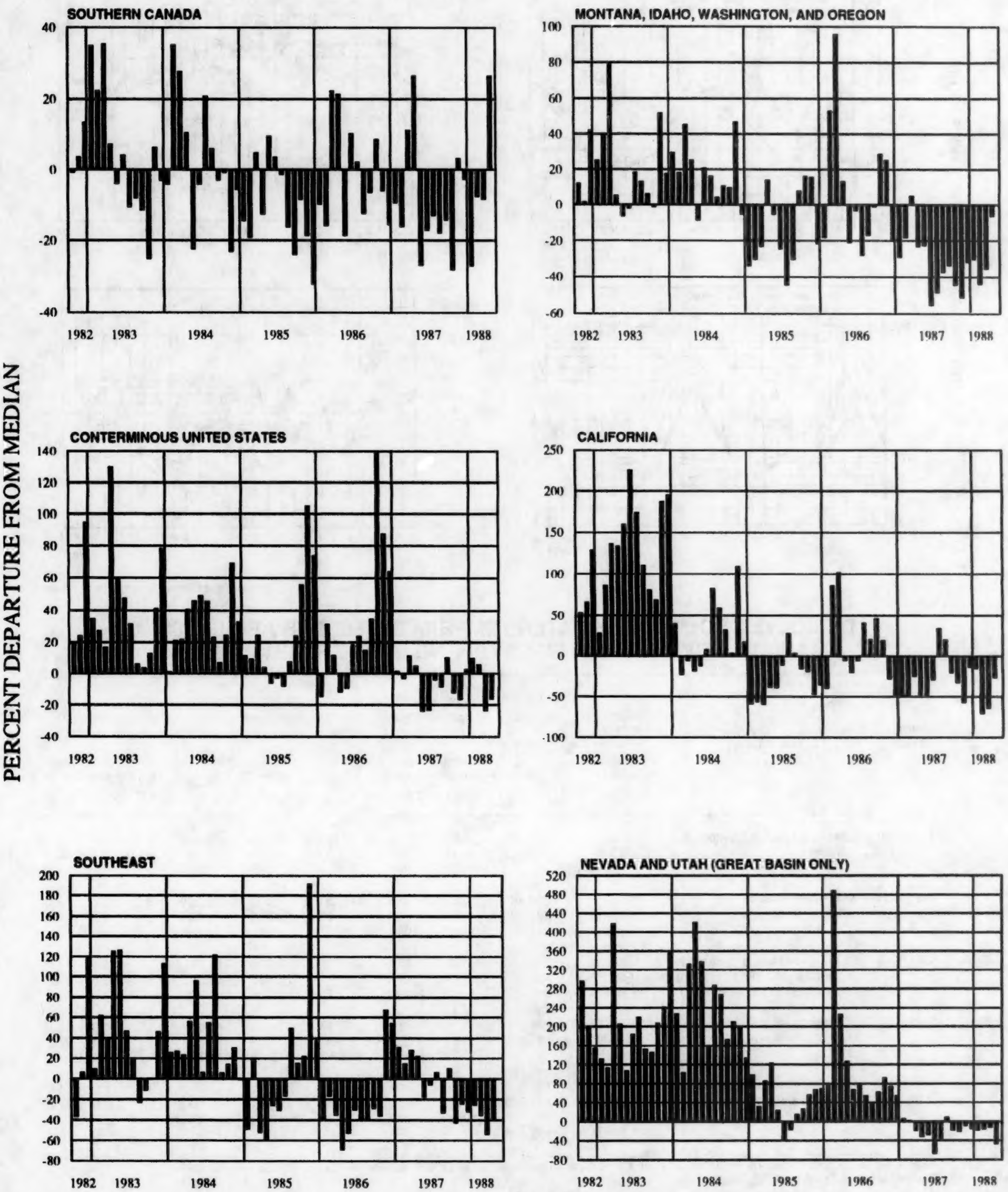
April 1988



ACTUAL MONTHLY STREAMFLOW, MAY 1, 1987 - APRIL 30, 1988
COMPARED WITH MEDIAN MONTHLY STREAMFLOW, 1951-80

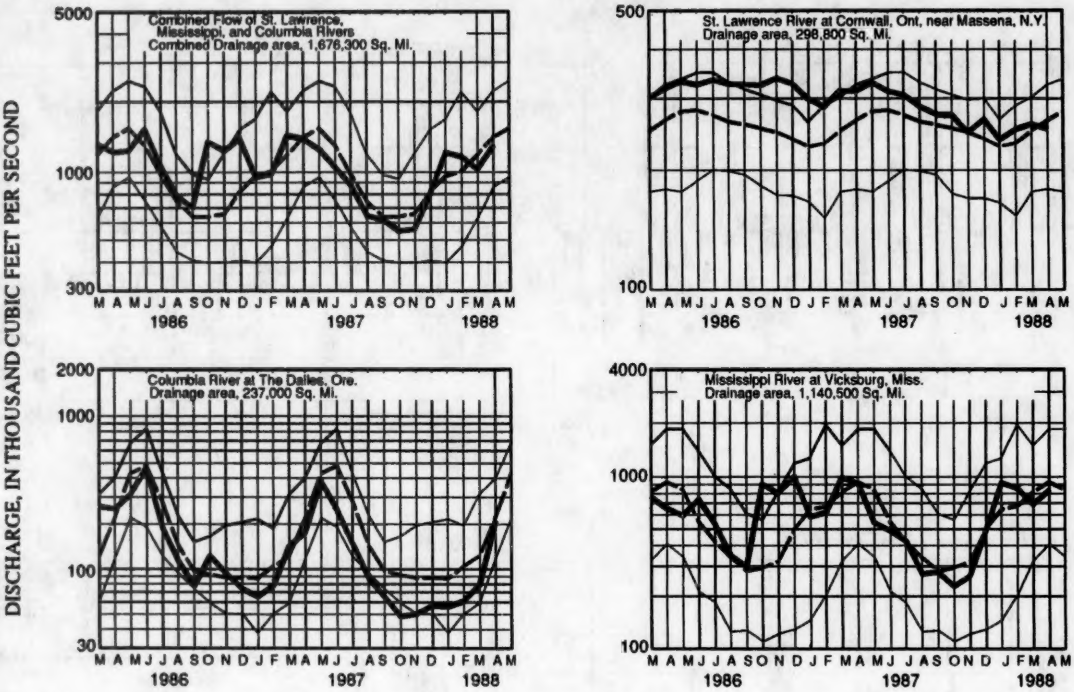


MONTHLY DEPARTURE OF ACTUAL STREAMFLOW (OCTOBER 1982-APRIL 1988) FROM MEDIAN STREAMFLOW (1951-80)



HYDROGRAPHS FOR THE "BIG THREE" RIVERS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR APRIL 1988, AT DOWNSTREAM SITES ON FIVE LARGE RIVERS

Station number	Station name	April data of following calendar years	Stream discharge during month Mean (cfs)	Dissolved-solids concentration[a] Minimum (mg/L)	Dissolved-solids concentration[a] Maximum (mg/L)	Dissolved-solids discharge[a] Mean (tons per day)	Dissolved-solids discharge[a] Minimum (tons per day)	Dissolved-solids discharge[a] Maximum (tons per day)	Water temperature[b] Mean in °C	Water temperature[b] Minimum in °C	Water temperature[b] Maximum in °C
01463500	Delaware River at Trenton, N.J.	1988	9,030	81	115	2,380	1,600	3,990	12.0	10.0	15.0
	(Morrisville, Pa.)	1945-87	22,210	46	124	----	1,200	21,500	---	3.0	22.5
		(Extreme yr)		(1962)	(1981)		(1985)	(1983)			
			[c]22,320								
07289000	Mississippi River at	1988	833,400	251	253	398,200	372,000	422,800	16.0	13.0	18.0
	Vicksburg, Miss.	1976-87	999,200	150	288	558,100	180,000	1,030,000	15.5	7.0	22.5
		(Extreme yr)		(1985)	(1986)		(1981)	(1979)			
			[c]930,400								
03612500	Ohio River at lock and dam 53,	1988	262,900	192	256	----	109,000	244,000	---	5.0	15.0
	near Grand Chain, Ill. (stream-	1955-87	436,400	117	282	----	22,400	462,000	---	6.5	19.0
	flow station at Metropolis, Ill.)	(Extreme yr)		(1957)	(1969)		(1976)	(1975)			
			[c]480,500								
06934500	Missouri River at Hermann,	1988	104,000	319	410	104,000	93,100	140,000	14.5	11.0	16.0
	Mo. (60 miles west of	1976-87	135,270	157	504	118,500	41,400	270,000	13.5	6.0	22.5
	St. Louis, Mo.)	(Extreme yr)		(1979)	(1981)		(1977)	(1984)			
			[c]88,120								
14128910	Columbia River at Warrendale,	1988	127,000	104	114	37,200	25,000	47,500	9.5	8.0	11.0
	Oreg. (streamflow station at	1976-87	204,900	85	128	58,100	22,300	96,100	9.0	6.5	12.5
	The Dalles, Oreg.)	(Extreme yr)		(1976)	(1985)		(1977)	(1984)			
			[c]220,700								

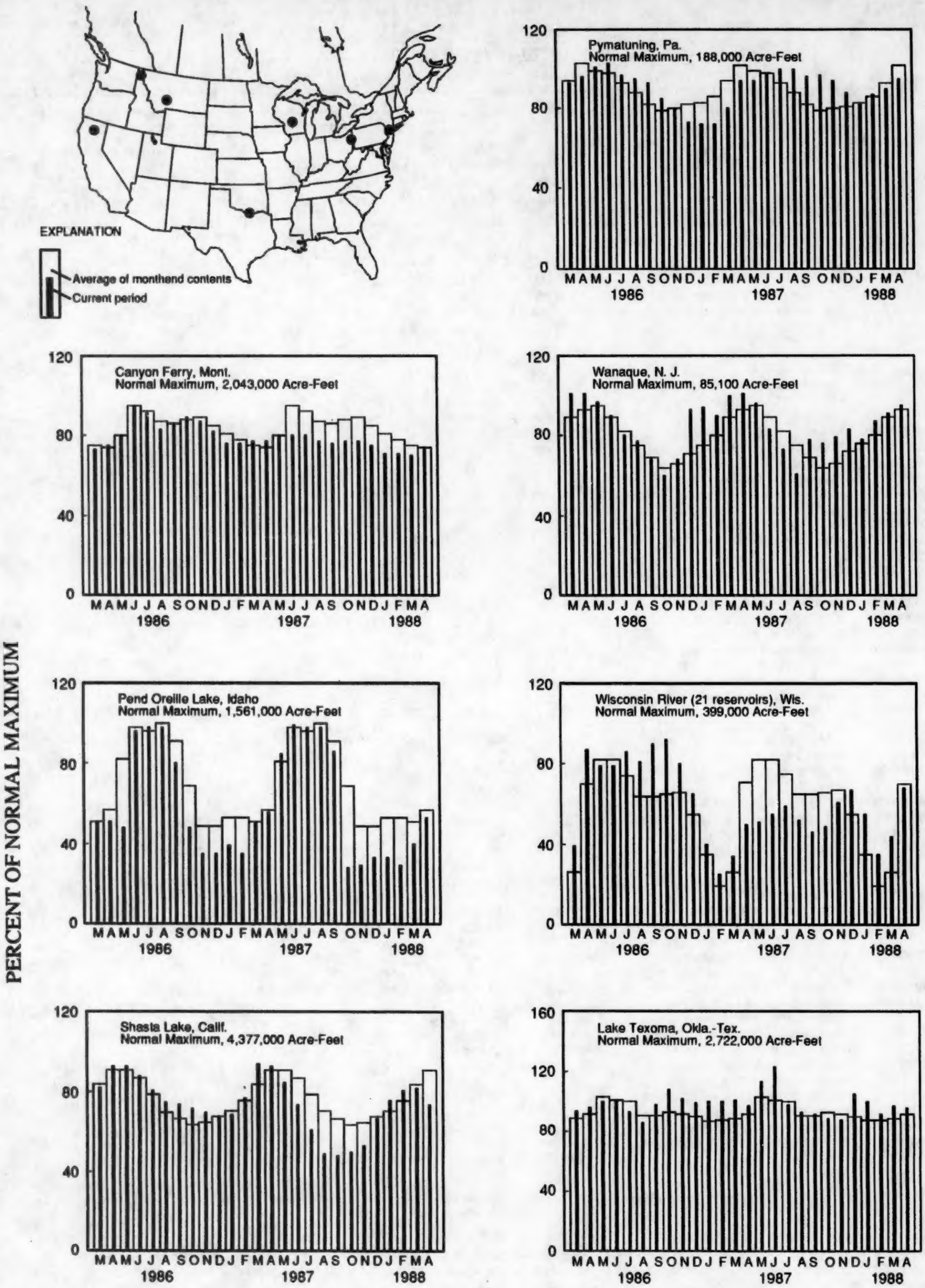
[a]Dissolved-solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1951-80, for comparison with data for current month.

FLOW OF LARGE RIVERS DURING APRIL 1988

Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1980 (cubic feet per second)	April 1988: Monthly mean discharge (cubic feet per second)	Percent of median monthly discharge 1951-80	Change in discharge from previous month (percent)	Discharge near end of month: Cubic feet per second	Discharge near end of month: Million gallons per day	Date
01014000	St. John River below Fish River at Fort Kent, Maine	5,690	9,647	28,780	137	+1,593	32,900	21,260	30
01318500	Hudson River at Hadley, N.Y.	1,664	2,909	5,750	64	+193	6,500	4,200	30
01357500	Mohawk River at Cohoes, N.Y.	3,456	5,734	6,600	48	−9	8,000	5,200	30
01463500	Delaware River at Trenton, N.J.	6,780	11,750	9,034	39	−43	8,990	5,810	30
01570500	Susquehanna River at Harrisburg, Pa.	24,100	34,530	32,060	44	−21	18,600	12,020	27
01646500	Potomac River near Washington, D.C.	11,560	[1]11,490	[1]12,300	66	+38	5,560	3,593	30
02105500	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	5,005	3,895	63	+39	....	....	..
02131000	Pee Dee River at Peedee, S.C.	8,830	9,851	5,593	42	−25	6,150	3,974	30
02226000	Altamaha River at Doctortown, Ga.	13,600	13,880	10,940	46	−33	21,300	13,770	29
02320500	Suwannee River at Branford, Fla.	7,880	6,987	8,200	81	−54	4,120	2,660	30
02358000	Apalachicola River at Chattahoochee, Fla.	17,200	22,570	18,900	57	−18	21,200	13,700	30
02467000	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	23,300	21,010	44	+69	7,550	4,879	30
02489500	Pearl River near Bogalusa, La.	6,630	9,768	24,120	139	+87	10,000	6,500	30
03049500	Allegheny River at Natrona, Pa.	11,410	[1]19,480	[1]25,500	70	+4	8,420	5,441	25
03085000	Monongahela River at Braddock, Pa.	7,337	[1]12,510	[1]11,280	58	−45	9,600	6,200	24
03193000	Kanawha River at Kanawha Falls, W.Va.	8,367	12,590	9,610	57	+27	9,300	6,010	28
03234500	Scioto River at Higby, Ohio	5,131	4,547	5,793	78	−9	1,860	1,202	29
03294500	Ohio River at Louisville, Ky.[2]	91,170	11,600	147,400	71	−2	67,200	43,430	28
03377500	Wabash River at Mount Carmel, Ill.	28,635	27,220	59,180	118	+64	21,700	14,020	28
03469000	French Broad River below Douglas Dam, Tenn.	4,543	6,798	5,558	49	+55	....	....	..
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,163	4,899	70	+18	3,617	2,337	30
04264331	St. Lawrence River at Cornwall, Ontario - near Massena, N.Y.[3]	298,800	242,700	253,000	95	−3	245,000	158,300	30
02NG001	St. Maurice River at Grand Mere, Quebec	16,300	25,150	54,500	124	+491	28,780	18,600	29
05082500	Red River of the North at Grand Forks, N.Dak.	30,100	2,551	4,311	49	+22	1,730	1,118	25
05133500	Rainy River at Manitou Rapids, Minn.	19,400	11,830	9,010	54	+64	7,080	4,575	25
05330000	Minnesota River near Jordan, Minn.	16,200	3,402	3,651	52	+3	2,150	1,389	30
05331000	Mississippi River at St. Paul, Minn.	36,800	[1]10,610	13,400	55	+41	9,400	6,080	30
05365500	Chippewa River at Chippewa Falls, Wis.	5,600	5,100	7,191	69	+56	2,950	1,906	30
05407000	Wisconsin River at Muscoda, Wis.	10,300	8,617	10,020	64	−1	8,550	5,525	30
05446500	Rock River near Joslin, Ill.	9,551	5,873	11,300	112	+28	8,500	5,490	30
05474500	Mississippi River at Keokuk, Iowa	119,000	62,620	85,940	67	+25	57,500	37,160	30
06214500	Yellowstone River at Billings, Mont.	11,796	7,038	2,990	75	+37	3,320	2,145	29
06934500	Missouri River at Hermann, Mo.	524,200	79,490	102,700	117	+21	85,800	55,450	30
07289000	Mississippi River at Vicksburg, Miss.[4]	1,140,500	576,600	833,400	90	+21	782,000	505,400	25
07331000	Washita River near Dickson, Okla.	7,202	1,368	4,300	459	−22	2,500	1,620	30
08276500	Rio Grande below Taos Junction Bridge, near Taos, N.Mex.	9,730	725	762	147	−10	445	287	30
09315000	Green River at Green River, Utah	44,850	6,298	6,137	115	+20	9,490	6,130	24
11425500	Sacramento River at Verona, Calif.	21,257	18,820	16,380	84	+49	....	....	..
13269000	Snake River at Weiser, Idaho	69,200	18,050	10,700	49	−6	9,350	6,043	30
13317000	Salmon River at White Bird, Idaho	13,550	11,250	11,200	109	+178	13,600	8,790	30
13342500	Clearwater River at Spalding, Idaho	9,570	15,480	27,700	96	+710	33,200	21,460	30
14105700	Columbia River at The Dalles, Oreg.[5]	237,000	[1]193,100	[1]208,600	95	+166	148,800	96,170	26
14191000	Willamette River at Salem, Oreg.	7,280	[1]23,510	[1]31,200	108	+24	19,000	12,300	26
15515500	Tanana River at Nenana, Alaska	25,600	23,460	9,947	124	+54	28,000	18,100	30
08MF005	Fraser River at Hope, British Columbia.	83,800	96,290	80,150	134	+181	150,100	97,010	29

[1]Adjusted.
[2]Records furnished by Corps of Engineers.
[3]Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y., when adjusted for storage in Lake St. Lawrence.
[4]Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5]Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS



USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF APRIL 1988

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F--Flood control I--Irrigation M--Municipal P--Power R--Recreation W--Industrial	Percent of normal maximum				Normal maximum (acre-feet)[a]
	End of Apr. 1988	End of Apr. 1987	Average for end of Apr.	End of Mar. 1988	
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	67	48	77	55	[b]226,300
QUEBEC					
Allard (P)	66	85	80	8	280,600
Gouin (P)	30	67	51	26	6,954,000
MAINE					
Seven reservoir systems (MP)	68	83	69	28	4,107,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	61	75	51	27	76,450
Lake Francis (FPR)	68	62	56	37	99,310
Lake Winnipesaukee (PR)	103	97	97	61	165,700
VERMONT					
Harriman (P)	82	86	79	26	116,200
Somerset (P)	70	86	75	63	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	84	96	89	79	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	74	90	91	40	786,700
Indian Lake (FMP)	89	82	91	59	103,300
New York City reservoir system(MW)	93	99	100	92	1,680,000
NEW JERSEY					
Wanaque (M)	95	101	93	91	85,100
PENNSYLVANIA					
Allegheny (FPR)	47	50	45	45	1,180,000
Pymatuning (FMR)	95	94	102	90	188,000
Raystown Lake (FR)	68	68	60	68	761,900
Lake Wallenpaupack (PR)	67	76	79	61	157,800
MARYLAND					
Baltimore municipal system (M)	92	87	94	92	261,900
NORTH CAROLINA					
Bridgewater (Lake James) (P)	90	100	93	86	288,800
Narrows (Badin Lake) (P)	93	100	100	77	128,900
High Rock Lake (P)	80	100	84	52	234,800
SOUTH CAROLINA					
Lake Murray (P)	89	92	83	85	1,614,000
Lakes Marion and Moultrie (P)	83	83	82	76	1,862,000
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	46	78	75	40	1,730,000
GEORGIA					
Burton (PR)	90	97	92	75	104,000
Sinclair (MPR)	88	88	91	89	214,000
Lake Sidney Lanier (FMPR)	49	65	63	46	1,686,000
ALABAMA					
Lake Martin (P)	88	98	95	82	1,375,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	47	75	61	39	2,293,000
Douglas Lake (FPR)	40	76	61	22	1,394,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	68	73	77	57	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	52	87	66	45	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	57	75	76	48	1,478,000
WISCONSIN					
Chippewa and Flambeau (PR)	94	75	72	82	365,000
Wisconsin River (21 reservoirs) (PR)	68	50	70	44	399,000
MINNESOTA					
Mississippi River headwater system (FMR)	36	33	31	22	1,640,000
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	72	87	84	74	22,700,000
SOUTH DAKOTA					
Angostura (I)	72	95	84	72	130,768
Belle Fourche (I)	88	96	71	81	185,200
Lake Francis Case (FIP)	81	81	87	80	4,589,000
Lake Oahe (FIP)	83	95	---	84	22,240,000
Lake Sharpe (FIP)	101	100	102	101	1,697,000
Lewis and Clark Lake (FIP)	81	74	90	78	432,000

Reservoir Principal uses: F--Flood control I--Irrigation M--Municipal P--Power R--Recreation W--Industrial	Percent of normal maximum				Normal maximum (acre-feet)[a]
	End of Apr. 1988	End of Apr. 1987	Average for end of Apr.	End of Mar. 1988	
NEBRASKA					
Lake McConaughy (IP)	81	82	79	81	1,948,000
OKLAHOMA					
Eufaula (FRP)	101	97	95	104	2,378,000
Keystone (FPR)	98	86	104	89	661,000
Tenkiller Ferry (FPR)	111	104	100	119	628,200
Lake Altus (FIMR)	99	100	56	99	133,000
Lake O'The Cherokees (FPR)	99	94	92	103	1,492,000
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	96	97	92	97	2,722,000
TEXAS					
Bridgeport (IMW)	81	100	53	81	386,400
Canyon (FMR)	99	99	80	98	385,600
International Amistad (FIMPW)	100	87	81	101	3,497,000
International Falcon (FIMPW)	98	85	67	104	2,668,000
Livingston (IMW)	99	100	90	100	1,788,000
Possum Kingdom (IMPRW)	65	67	94	65	570,200
Red Bluff (PI)	67	89	27	73	307,000
Toledo Bend (P)	94	91	90	90	4,472,000
Twin Buttes (FIM)	82	68	32	84	177,800
Lake Kemp (IMW)	87	101	85	88	268,000
Lake Meredith (FWM)	35	30	36	35	796,900
Lake Travis (FIMPRW)	90	98	81	92	1,144,000
MONTANA					
Canyon Ferry (FIMPR)	74	77	74	70	2,043,000
Fort Peck (FPR)	77	85	83	78	18,910,000
Hungry Horse (FIPR)	30	77	57	24	3,451,000
WASHINGTON					
Ross (PR)	27	30	28	8	1,052,000
Franklin D. Roosevelt Lake (IP)	71	89	47	36	5,022,000
Lake Chelan (PR)	39	30	39	15	676,100
Lake Cushman (PR)	77	84	88	64	359,500
Lake Merwin (P)	103	103	101	94	245,600
IDAHO					
Boise River (4 reservoirs) (FIP)	54	67	72	44	1,235,000
Coeur d'Alene Lake (P)	83	87	123	62	238,500
Pend Oreille Lake (FP)	53	56	57	40	1,561,000
IDAHO--WYOMING					
Upper Snake River (8 reservoirs) (MP)	76	71	74	67	4,401,000
WYOMING					
Boysen (FIP)	68	72	61	69	802,000
Buffalo Bill (IP)	48	68	61	49	421,300
Keyhole (F)	43	45	47	43	193,800
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs(I)	69	79	55	63	3,056,000
COLORADO					
John Martin (FIR)	78	97	20	83	364,400
Taylor Park (IR)	75	51	54	71	106,200
Colorado-Big Thompson project (I)	70	80	59	69	730,300
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	86	100	---	84	31,620,000
UTAH--IDAHO					
Bear Lake (IPR)	77	79	65	75	1,421,000
CALIFORNIA					
Folsom (FIP)	50	71	74	45	1,000,000
Hetch Hetchy (MP)	35	44	39	38	360,400
Isabella (FIR)	23	43	36	23	568,100
Pine Flat (FI)	28	72	63	24	1,001,000
Clair Engle Lake (Lewiston) (P)	79	90	87	76	2,438,000
Lake Almanor (P)	78	88	61	74	1,036,000
Lake Berryessa (FIMW)	75	86	90	77	1,600,000
Millerton Lake (FI)	62	48	67	49	503,200
Shasta Lake (FIPR)	74	93	91	82	4,377,000
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	27	69	60	28	744,600
NEVADA					
Rye Patch (I)	42	71	74	42	194,300
ARIZONA--NEVADA					
Lake Mead and Lake Mohave(FIMP)	93	92	69	94	27,970,000
ARIZONA					
San Carlos (IP)	57	85	31	56	935,100
Salt and Verde River system(IMPR)	96	99	56	90	2,019,100
NEW MEXICO					
Conchas (FIR)	85	100	78	88	330,100
Elephant Butte and Caballo (FIPR)	95	94	35	94	2,442,000

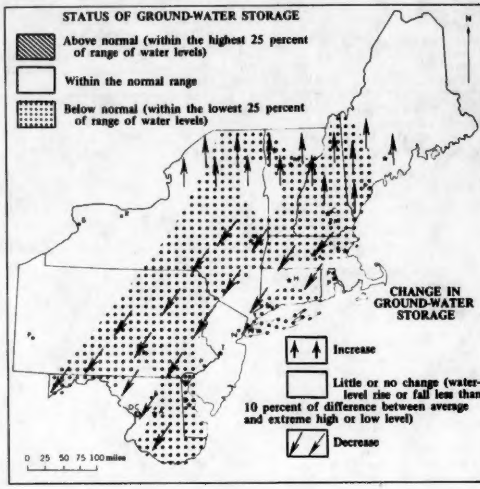
[a]1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second day.
[b]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

GROUND-WATER CONDITIONS DURING APRIL 1988

Ground-water levels rose in north-central New England and declined in most of Massachusetts and Connecticut. (See map.) Levels declined also in southeastern New York State, eastern Pennsylvania, and in most of Maryland. Water levels near the end of April were below average for this time of year in about one-half of the northeast region, including most of central New England, eastern New York State, central Pennsylvania, and nearly all of Maryland (except central part), and Delaware.

In the Southeastern States, ground-water levels rose in Kentucky and Arkansas, and held steady or rose in West Virginia. Levels declined in most wells in Mississippi. Net changes in levels were mixed in Virginia, North Carolina, Louisiana, and Georgia. Water levels were above long-term averages in Kentucky and North Carolina, and below average in Arkansas, Louisiana, and in most wells in Virginia. Levels were mixed with respect to average in West Virginia. New low levels for April occurred in key wells in Memphis, Tennessee; Stuttgart, Arkansas; Ruston, Louisiana; Montgomery, Alabama; and Cockspur Island, Savannah area of Georgia. All of these lows occurred despite net rises in each of the wells during the month.

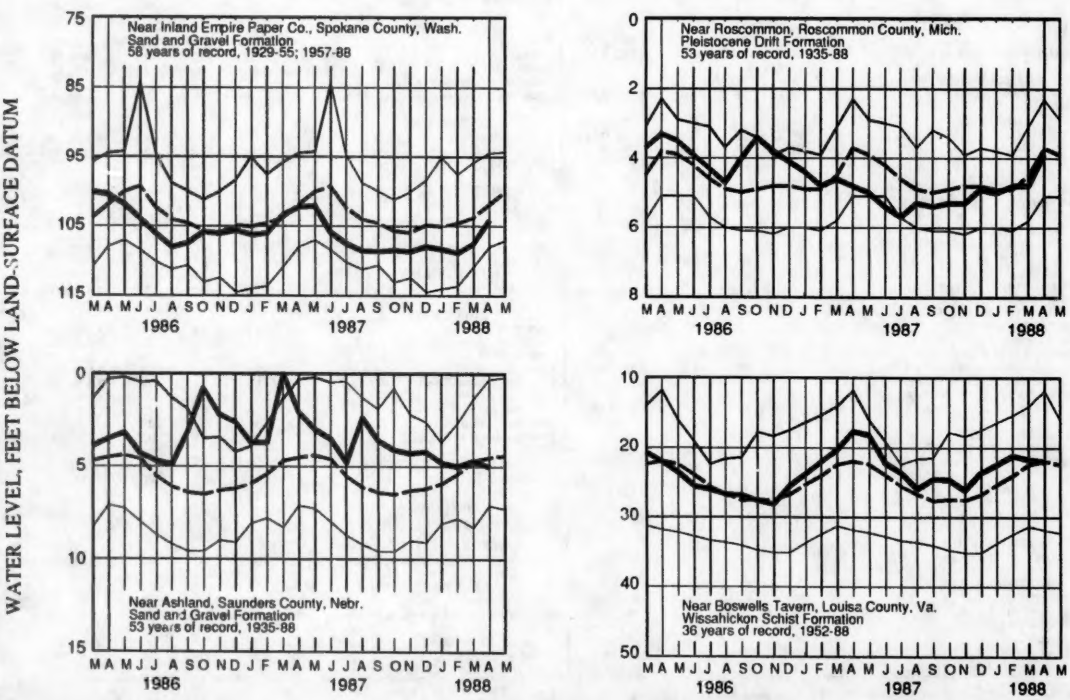
In the central and western Great Lakes States, ground-water levels rose in Minnesota, Wisconsin, Michigan, and Indiana, and declined in Ohio. Levels



Map showing ground-water storage near end of April and change in ground-water storage from end of March to end of April.

MONTHEND GROUND-WATER LEVELS IN KEY WELLS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.



changed variably in Iowa. In Indiana, water levels were generally above long-term averages, and, in Wisconsin, close to average. Levels were below average in Ohio and Iowa, and mixed with respect to average in Minnesota and Michigan.

In the Western States, ground-water levels rose in Washington, North Dakota, and Nevada; levels declined in Idaho and southern California. Mixed water-level changes occurred in Nebraska, Utah, Kansas, Arizona, New Mexico, and Texas. Water levels were mixed with respect to long-term averages in Washington, North Dakota, southern California, Nevada, Utah, New Mexico, and Texas. Levels were below average in Idaho, Kansas, and Arizona. A new April high level occurred in the Berrendo-Smith key well in New Mexico, despite a net decline during the month of more than 3 feet. New low levels for April occurred in the key well at the Kansas Agricultural Experiment Station in Colby, Kansas, and, despite a slight net rise during the month, in the observation well in Wyndmere, North Dakota. A new all-time high water level occurred in the key well in Steptoe Valley in Nevada (38 years of record), and a new all-time low level occurred in the key well in the El Paso area in western Texas (23 years of record).

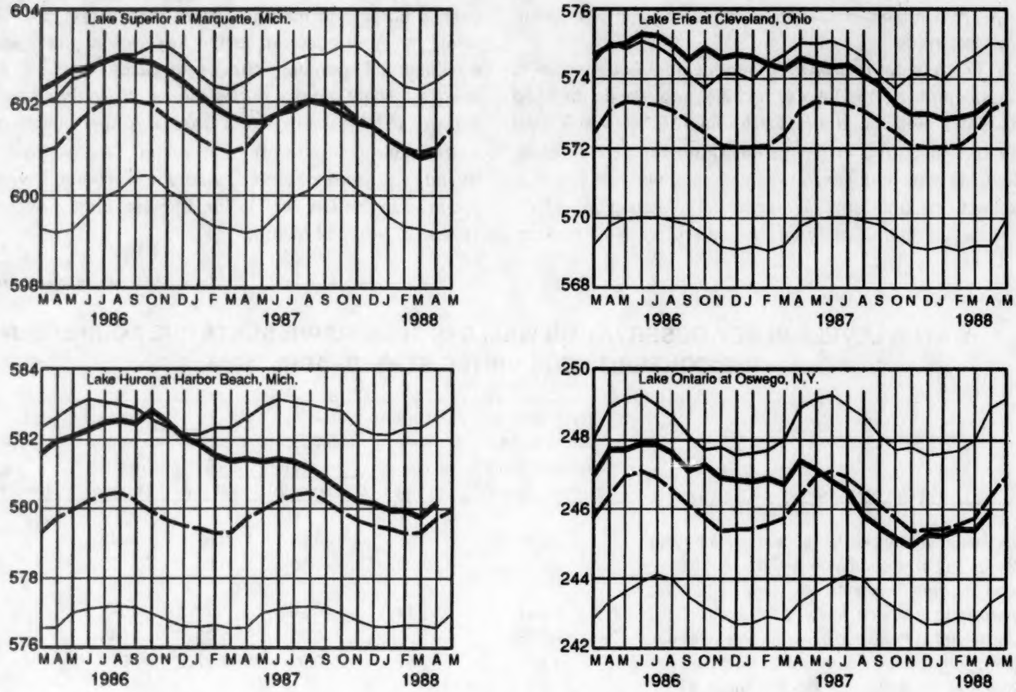
Provisional data; subject to revision

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES--APRIL 1988

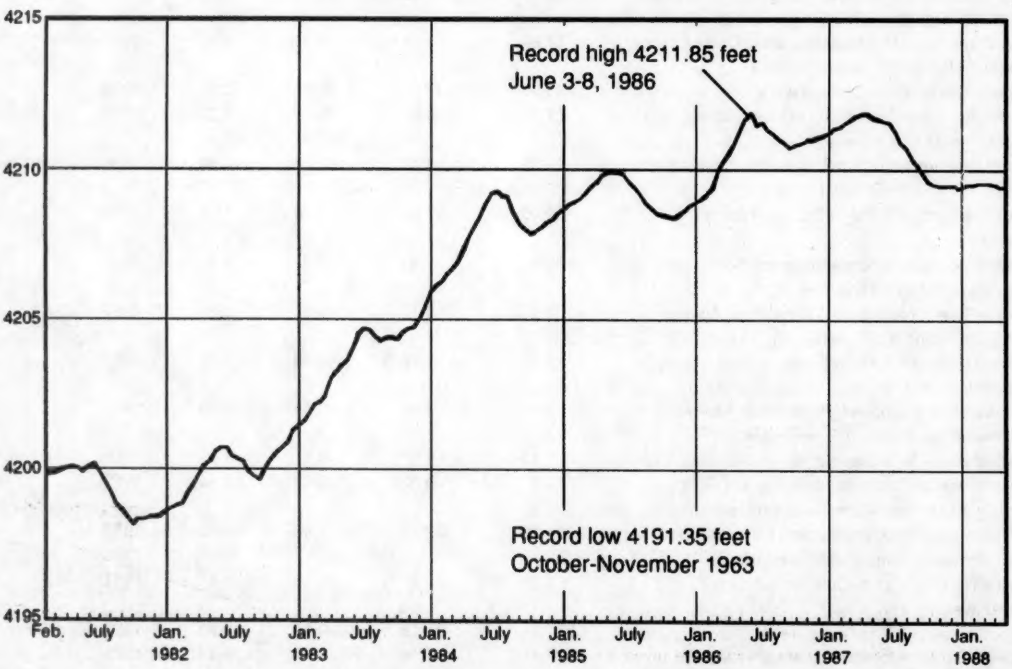
Aquifer and Location	Water level in feet with reference to land-surface datum	Departure from average in feet	Net change in water level in feet since: Last month	Last year	Year records began	Remarks
Glacial drift at Hanska, south-central Minnesota	–5.86	–0.32	+3.28	–0.57	1942	
Glacial drift at Roscommon in north-central part of Lower Peninsula, Michigan.	–3.90	–0.09	+0.95	+0.90	1935	
Glacial drift at Marion, Iowa	–4.41	–1.14	–0.28	–1.11	1941	
Glacial drift at Princeton in northwestern Illinois	–5.75	+1.93	+0.75	+1.73	1943	
Petersburg Granite, southeastern Piedmont near Fall Zone, Colonial Heights, Virginia.	–15.74	–1.51	–0.01	–3.27	1939	
Glacial outwash sand and gravel, Louisville, Kentucky (U.S. well no. 2).	–19.81	+4.96	+0.03	–1.23	1946	
500-foot sand aquifer near Memphis, Tennessee (U.S. well no. 2).	–105.99	–16.59	+0.06	–0.60	1941	April low.
Weathered granite, Mocksville area, Davie County, western Piedmont, North Carolina.	–17.80	+1.18	–0.24	–2.67	1932	
Sparta Sand in Pine Bluff industrial area, Arkansas	–235.50	–27.52	+0.85	–5.50	1958	
Eutaw Formation in the City of Montgomery, Alabama (U.S. well no. 4).	–27.3	–8.3	+0.6	–3.2	1952	April low.
Limestone aquifer on Cockspur Island, Savannah area, Georgia (U.S. well no. 6).	–33.58	–7.47	–0.72	–0.98	1956	April low.
Sand and gravel in Puget Trough, Tacoma, Washington.	–102.06	+3.97	+0.70	–1.16	1952	
Pleistocene glacial outwash gravel, North Pole, northern Idaho (U.S. well no. 3).	–468.6	–7.3	–0.3	–5.7	1929	
Snake River Group: Snake River Plain Aquifer, at Eden, Idaho (U.S. well no. 4).	–124.9	–3.1	–0.2	–2.3	1957	
Alluvial valley fill in Flowell area, Millard County, Utah (U.S. well no. 9).	–19.68	+11.76	–4.93	–5.77	1929	
Alluvial sand and gravel, Platte River Valley, Ashland, Nebraska (U.S. well no. 6).	–5.07	–1.31	–0.31	–2.90	1935	
Alluvial valley fill in Steptoe Valley, Nevada	–6.13	+6.06	+0.17	+0.41	1950	All-time high.
Pleistocene terrace deposits in Kansas River valley, at Lawrence, northeastern Kansas.	–20.61	–0.02	–0.09	–5.34	1953	
Alluvium and Paso Robles clay, sand, and gravel, Santa Maria Valley, California.	–131.15	+7.70	–1.40	...	1957	
Valley fill, Elfrida area, Douglas, Arizona (U.S. well no. 15).	–101.3	–20.2	+0.6	+1.4	1951	
Hueco bolson, El Paso area, Texas	–270.31	–21.18	–0.67	–3.73	1965	All-time low.
Evangeline aquifer, Houston area, Texas	–290.81	+5.79	+2.57	+19.43	1965	

GREAT LAKES ELEVATIONS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Ocean Service.



Fluctuations of Great Salt Lake, February 1981 through April 1988



TEMPERATURE OUTLOOK FOR MAY THROUGH JULY 1988

PRECIPITATION OUTLOOK FOR MAY THROUGH JULY 1988

NATIONAL WATER CONDITIONS
APRIL 1988

Based on reports from the Canadian and U.S. Field offices; completed June 7, 1988

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(Continued from page 7.)

In Utah and Nevada, streamflow conditions are based on actual streamflow at four index stations in the Great Basin. Actual and median streamflow for the three index stations in Utah which measure streamflow in the Colorado River basin is much greater than that of the index stations in the Great Basin. Hydrology of the two basins is also different. A truer picture of streamflow in these two States is shown by focusing on the Great Basin because most of Nevada and about half of Utah lie in the Great Basin. Also, almost all of the Great Basin is in Nevada and Utah.

Actual streamflow was below median for 11 of the last 12 months, ranging from 8 percent to 67 percent below median in the 11 months. Actual August 1987 streamflow was 8 percent above median. Streamflow was in the below-normal range in most of Nevada and Utah during June, July, and August 1987, and much of the two States during September and October 1987. Small areas of below-normal range streamflow occurred in those States from November 1987 through March 1988. Actual April streamflow was 47 percent below median May streamflow. May median streamflow is twice the April median streamflow (108 percent more).

The departure from median graph shows that actual streamflow was well above median, with the exception of June-July 1985, from October 1982 through December 1986. Streamflow has been below median since January 1986.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--averaged a normal 1,295,000 cfs (8 percent below median) during April, after a 26 percent increase from March to April. This month's combined flow was the second lowest for April in the last 6 years: only 75,000 cfs (6 percent) higher than the April 1986 average. Mean flow of all three rivers was in the normal range for April: for the third consecutive month on the Mississippi River at Vicksburg, Mississippi; for the fourth consecutive month on the St. Lawrence River at Cornwall, Ontario; and for the first time in 11 months on the Columbia River at The Dalles, Oregon. Hydrographs for both the combined and individual flows of the "Big 3" are shown on page 12. Dissolved solids and water temperatures at five large river stations are given on page 12. April flows of the "Big 3" and other large rivers are given in the Flow of Large Rivers table on page 13.

Contents of 63 percent of reporting reservoirs were near or above average for the end of April, compared with the 60 percent in that category for the end of March. Normal maximum contents of 10 of the 16 index reservoirs in the Southeast, including all of those in the Tennessee Valley, exceeds 1,000,000 acre-feet. The contents of 9 of these 10 large reservoirs ranged from 6 percent to 46 percent below the average for the end of March. At the end of April, the contents of 8 of those 9 were still 7 to 39 percent below average. April 1988 monthend contents for 5 of those 10 index reservoirs were also below April 1986 monthend contents. All five index reservoirs in the Tennessee Valley were below the monthend averages for March and April. The Tennessee Valley reservoirs are generally located near the Tennessee-North Carolina border. Contents of reservoirs other than those in the West and Southeast--in Canada, the northeastern United States, and also Wisconsin and Minnesota--were generally below average in Canada and New York, and above average in New Hampshire. Graphs of contents for seven reservoirs are shown on page 14 with contents for the 100 reporting reservoirs given on page 15.

Mean April elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) were in the normal range. Only Lake Erie, which was in the above-normal range October-December 1987 and February-March 1988, and Lake Ontario, which was in the below-normal range during October 1987, have been at non-normal levels during the 1988 water year. Levels ranged from 0.68 foot (Lake Superior) to 2.29 feet (Lake Huron) lower than those for April 1987. Stage hydrographs at the master gages for Lakes Superior, Huron, Erie, and Ontario are on page 18.

The elevation of Utah's Great Salt Lake (graph on page 18) was 4,209.45 feet above National Geodetic Vertical Datum (NGVD) of 1929 on April 30. Lake level fell 0.10 foot April 1-15, reaching 4,209.40 feet above NGVD, then rose 0.05 foot by the end of the month. Although the monthend level is 2.25 feet lower than that of April 30, 1987, there are only four April 30 elevations which are higher than that of 1988--those of 1987, 1986, 1985, and 1876, in descending order.

May-July 1988 outlook maps for both temperature and precipitation are on page 19.

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